Subject:	INFORMATION: Failsafe Tab Control Systems, FAR 25.629	Date:	AUG 9, 1984
From:	Leroy A. Keith Manager, Aircraft Certification Division, ANM-100	Reply to	Attn. Of: Haynes FTS 446-2113
To:	Managers, ANE-100, ASW-100, ACE-100, AWS-100		

There have been continuing requests for guidance in sharing compliance wish the failsafe tab requirements of Section 25.629. The recommendations below were, for the most part, issued in our letter of Feb. 17, 1981, t o ASW-210 with copies sent to other regions. The recommendations are repeated here with additional guidance for residual strength determination for dual load path tab control systems.

Compliance with the freedom from flutter requirements of Section 25.629(d) for control surface tabs may be demonstrated by either a multiple load path tab design or by an adequately balanced tab with appropriate substantiation showing freedom from flutter with a single failure in the tab control system.

Recommendations for dual load path method.

Compliance with the flutter failsafe failure criteria for trim tab systems may be shown by multiple load paths in the tab control system up to the point where the system is irreversible.

The multiple load path method would require an assessment of residual fatigue and static strength after the single failure to assure that the remaining load path would not fail before the single failure was detected. This assessment should include the establishment of a conservative inspection period and inspection method. This procedure is considered to be necessary in view of adverse service experience where both tab rods have failed. Section 25.601 provides an adequate regulatory basis to require this assessment. For those airplanes whose certification basis included Amendment 45 to FAR 25, Section 25.571 provides a specific regulatory basis for this assessment.

The following criteria are recommended for evaluating the residual strength capability of the tab control system. These specific recommendations are based on the premise that the tab control rods are dual, adjacent to each other, and not easily inspectable for cracks. Other installations will have to be evaluated on their own merits.

(a) A loading spectrum must be established for the tab that includes high energy buffet from the propeller slip stream or from other sources. Flight strain measurements are recommended.

(b) One tab rod should be assumed to have a crack that has grown from an initial .005 inch initial quality flaw for one airplane lifetime under the loading spectrum in the unfailed configuration.

(c) With the opposite rod failed, the remaining rod [with the crack determined by (b) above] should be able to sustain limit load for two inspection intervals. The inspection being conducted to detect the initial failed rod.

(d) The inspection interval in (c) should be predicated on a crack growth under the load spectrum as applied to the failed configuration. That is, with one rod failed, the crack growth should be from the final crack length determined in (b) to a critical crack length capable of sustaining limit load.

Recommendations for balanced tab flutter analysis.

The balanced tab method of demonstrating compliance is acceptable provided the analytical technique is conservative, based on experimental data, and conducted by flutter analysts with considerable experience in tab flutter analysis. Tab flutter analyses are exceptionally complex and subject to considerable unreliability if the above provisions are not met.

It is essential that the steady aerodynamic hinge moments of the control surface and tab be determined from experimental data and the quasi-steady aerodynamic coefficients used in the flutter analysis be adjusted to match these experimental values at zero frequency. Although theoretical coefficients are higher and tend to reduce the critical flutter speed, they also provide a higher aerodynamic damping and consequently may suppress the typical hump modes associated with control surface and tab flutter. Both theoretical and adjusted coefficients should be used since the flutter made. could be either speed critical or damping critical. Once the analysis has been conducted with the nominal experimentally adjusted values of hinge moment coefficients, the analysis should be conducted with parametric variations of these coefficients.

If the above recommendations are followed and the flutter clearance is marginal in either speed or damping for any of the analysis conditions, further substantiation by test should be required.

Recommendations for balanced tab flutter tests.

Either representative wind tunnel flutter model tests to V_D or flight flutter tests to the range of critical speeds shown by analysis should be conducted if the analysis is marginal. The tab failure may be simulated by free play provided the free play is sufficient and the test can be conducted without the tab grounded at either limit. The location of the failure in the tab system should be selected with regard to the extent that tab control system components contribute to the tab balance and tab inertia. The critical combination of these values, as indicated by the analysis, should be evaluated.

MIL-A-8870A provides tab rotational free play limits below which the tab is considered irreversible. Since these are conservative limits, the free play established to simulate a free tab should be well above these limits. The tab and control surface should be rendered as friction free as possible and normal slop resulting from wear, deterioration, or manufacturing variability should be induced in the tab hinges along with the tab rotational free play.

The exact amount of tab rotational free play should be established for each specific case depending on tab and control surface geometry. It should be well above the MIL-A-8870A limit of 1.15 degrees, sufficient to assure that the tab will float free at the test speed. Five degrees have been accepted on several occasions to represent a failed tab. Lesser values could be acceptable, provided adequate instrumentation were installed, to determine if the tab were free floating at the test speed.

Other single failure considerations.

In addition to single failures in the tab control system, the failure of a tab supporting hinge should be considered under Section 25.629(d). This failure mode can result in a large reduction in tab rotational frequency, particularly when the tab rods are connected close to the failed hinge. This condition can be critical whether or not dual tab rods are used.

Signed by Leroy A Keith